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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Fourth Semester, B.E. - Computer Science and Engineering

Semester End Examination; August - 2023

Theory of Computation

Time: 3 hrs *Max. Marks: 100*

Course Outcomes

The Students will be able to:

CO1: Design finite automata.

CO2: Apply regular expression for lexical analysis phases.

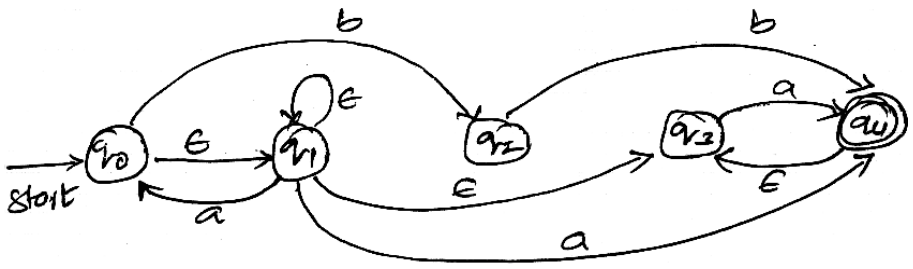
CO3: Design grammars for various languages.

CO4: push-down automata from grammars and grammar to pda.

CO5: Design Turing machines for simple languages and design problem reductions to determine the un-decidability of languages.

***Note**: I) **PART-A** is compulsory. **Two** marks for each question.*

*II) **PART-B**: Answer any **Two** sub questions (from a, b, c) for a Maximum of **18 marks** from each unit.*

Q. No.	Questions	Marks	BLs	COs
	I : PART - A	**10**		
1 a.	Define ∈–Closure.	2	L1	CO1
b.	Write a regular expression to accept the set of strings of 0's and 1's ends with 1 and does not contain the substring 00.	2	L2	CO2
c.	Write content free grammar for the following regular expression: $(ab)^* a (a + b)^*$	2	L2	CO3
d.	Define deterministic pushdown automata.	2	L1	CO4
e.	Define Turing Machine.	2	L1	CO5
	II : PART – B	**90**		
	UNIT – I	**18**		
2 a.	Construct the deterministic finite automata for the given language; $\alpha = \{W \mid W \in \{a, b\}^* \text{ and } \mid W \mid \bmod 3 > \mid W \mid \bmod 2\}$ Show that the string 'bbabb' is accepted or not by using intended transition function.	9	L6	CO1
b.	Write subset construction algorithm and convert the following ∈–NFA to DFA. 	9	L3	CO2

Contd... 2

c. What are distinguishable and indistinguishable state and minimize following DFA.

δ	0	1
→ A	B	A
B	A	C
C	D	B
*D	D	A
E	D	F
F	G	E
G	F	G
H	G	D

9 L3 CO1

18

UNIT - II

3 a. State and prove the pumping Lemma for regular languages and show that $L = \{a^n b^n \mid n \geq 1\}$ is not regular. 9 L2 CO2

b. Prove that every language defined by regular expression is also defined by finite automate and convert the given RE to ∈ – NFA. 9 L2 CO2

$a^* + b^* + c^*$

c. Consider the following languages defined over $\sum = \{0, 1\}$

L_1 = { the set of all string containing atleast one 0}

i) Write regular expression for L_1 and L_2

ii) Draw the DFA for L_1 and L_2

iii) Draw the DFA to recognizing the languages

$L_1 \cup L2$, $L_1 \cap L_2$, $L_1 - L_2$ 9 L3 CO2

UNIT - III **18**

4 a. Design the CFG for the language

$L = \{ab\ (bbaa)^n\ bba\ (ba)^n \mid n \geq 0\}$ and also construct the derivation free for the input string abbbaabbaba by using left most and right most deviation. 9 L6 CO3

b. Mention the applications of CFG and explain any two applications in detail. 9 L2 CO3

c. Convert the following CFG to CNF

$S \rightarrow aA \mid aBB$

$A \rightarrow aaA/\in$

$B \rightarrow bB / bbC$

$C \rightarrow B$ 9 L3 CO3

Contd... 3

UNIT - IV **18**

5 a.	Define PDA design deterministic pushdown automata for the language $L = \{a^n b^m c^{n+m} \mid n \geq 1, m \geq 1\}$ and also show the ID for the input string "abbccc".	9	L5	CO4
b.	Convert the PDA to a CFG, if f is given by $P = \{ \{p, q\} \{0, 1\} \{ x, Z\} \delta, q, Z) \}$ $\delta (q, 1, Z) = \{(q, XZ) \}$ $\delta (q, 1, X) = \{(q, XX) \}$ $\delta (q, \in, X) = \{(q, \in) \}$ $\delta (q, 0, X) = \{ (p, X)\}$ $\delta (p, 1, X) = \{p, \in \}$ $\delta (p, 0, Z) = \{ (q, Z)\}$	9	L3	CO4
c.	Define Language of PDA and convert the following CFG to PDA: $S \rightarrow aA$ $A \rightarrow aA \mid bA \mid a \mid b$	9	L1 L3	CO4

UNIT - V **18**

6 a.	Design Turing machine for the language to accept the set of strings with equal number of 0's and 1's and also show the instantaneous description for the input string "110100".	9	L6	CO5
b.	Explain the multitape and multistack Turing machine with neat diagram.	9	L2	CO5
c.	Write short notes on the following: i) Recursively enumerable languages ii) Nondeterministic Turing machine iii) Post correspondence problem	9	L2	CO5

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